

Lab 5. Reflection and Transmission

Name: _____

Section: _____

Due before lab.

Tasks 9&10. The Thracian Tomb

After the discovery of a large number of Thracian tombs in the “Valley of Roses” in central Bulgaria, the archeologists started calling this area the “Valley of the Thracian Kings”. Many of the tombs are situated near Seuthopolis, the capital of the Odrysian kingdom since 320 BC. The cemetery of Seuthopolis included a number of tholos tombs, in which the upper-class were interred, sometimes along with their horses*. These vaulted "beehive" tombs comprise a narrow corridor and a round burial chamber covered by tumuli.

A plenty of small artificial hills are spread all over the valley and it is believed that most of them hide Thracian tombs. Treasure hunters are constantly undertaking small scale excavation works plundering the mounds. However, the Bulgarian Ministry of Culture cannot afford ubiquitous excavation works to prevent the plundering. They need to know with certainty whether a hill is a tumulus or not, to save time and money and forestall the treasure hunters.

You have been invited by the Bulgarian Ministry of Culture to help them in determining the archeological value of the hills. You’ve accepted. Your idea is to use a small EM wave generator and a receiver (a hand-made GPR) to probe the subterranean recesses. The EM generator emits a very narrow beam, with a cross-section smaller than the receiving aperture of the receiver.

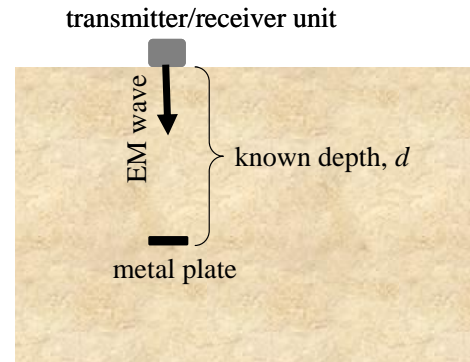
Briefly explain the principle of operation of the Ground Penetrating Radar (GPR):

* In book 5, Herodotus describes the customs of various Thracian tribes.

The Thracians who live above the Crestonaeans observe the following customs. Each man among them has several wives; and no sooner does a man die than a sharp contest ensues among the wives upon the question which of them all the husband loved most tenderly; the friends of each eagerly plead on her behalf, and she to whom the honor is adjudged, after receiving the praises both of men and women, is slain over the grave by the hand of her next of kin, and then buried with her husband. The others are sorely grieved, for nothing is considered such a disgrace. Their wealthy ones are buried in the following fashion. The body is laid out for three days; and during this time they kill victims of all kinds, and feast upon them, after first bewailing the departed. Then they either burn the body or else bury it in the ground. Lastly, they raise a mound over the grave, and hold games of all sorts, wherein the single combat is awarded the highest prize. Such is the mode of burial among the Thracians.

Before you start the real work, you need to undertake some preliminary measurements that will allow you to determine the soil parameters. You know that the conductivity, σ , and the permittivity, ϵ , strongly depend on the composition of the soil and the recent weather conditions, so you cannot use averaged values reported in books and technical papers.

You decide to dig a pit and bury a metal plate at certain depth, d , and then place the transmitting/receiving unit directly above the plate on the earth surface, shown in the figure to the right. By measuring the received signal, E_R , and the time, τ , it needs to reach the receiver, you hope to be able to deduce the soil parameters, eventually.



Briefly explain what happens to the emitted by the transmitter EM wave and provide the math expression that relates the received signal strength to the depth, at which the metal plate is.
